Recognizing Non-Bragg Scattering of Microwaves from the Sea Surface

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Bragg /Composite Surface scattering theory predicts that the average HH cross section is smaller than the average VV cross section. This is found to be true for backscattering from the sea surface if sufficient averaging is carried out. However, if only a small amount of temporal averaging is done, then HH cross sections occasionally exceed those at VV, and a practice has developed of calling such occurrences “Non-Bragg Scattering”. In this paper we will show that this label is erroneous. In fact, due to fading, that is the interference of fields backscattered from different locations within the illuminated area of sea surface, Bragg/Composite Surface scattering theory does allow the possibility that HH cross sections will exceed VV cross sections if insufficient averaging is done. We have compared the results of simulations of probability distributions of polarization ratios using Bragg/Composite Surface theory with those actually measured on the ocean. We have made these comparisons for a variety of wind speeds, incidence angles, and averaging times. We find that for incidence angles between about 30 and 50 degrees, Bragg/Composite Surface theory yields distributions that are in very good agreement with measurements. As the incidence angle increases, the agreement degrades due to under-prediction of the HH cross section by the theory. However, probability distributions of cross sections at HH polarization show that this under-prediction is not a result of a few very high HH cross sections but rather due to an under-prediction of cross sections through out the distribution by the theory. Thus the possibility exists that Bragg/Composite Surface theory also does not explain HH cross sections at incidence angles above about 50 degrees. This is in addition to the well known failure of theory at low incidence angles, a failure that is easily remedied by evaluating the complete Kirchoff integral. The occurrence of occasional samples of HH cross sections exceeding those at VV in time series that have been averaged over only short time periods is not sufficient to indicate “Non-Bragg Scattering”, however.